**Normal Forms in DBMS**

***Super key*** is a single key or a group of multiple keys(may contain non-necessary attributes) that can uniquely identify tuples in a table.

***Candidate key*** is a single key or a group of multiple keys(composite key) that uniquely identify rows in a table. A Candidate key is a subset of Super keys and is **devoid of any unnecessary attributes** that are not important for uniquely identifying tuples.

# 1. First Normal Form

A relation is in first normal form if every attribute in that relation is **singled valued attribute**.

# 2. Second Normal Form

A relation is in 2NF if it has **No Partial Dependency,**i.e.**,**no non-prime attribute (attributes which are not part of any candidate key) is dependent on any proper subset of any candidate key of the table.

# 3. Third Normal Form

A relation is in third normal form, if there is **no transitive dependency** for non-prime attributes as well as it is in second normal form.

If A -> B, B -> C, then A -> C is a transitive dependency

Table

Description automatically generated

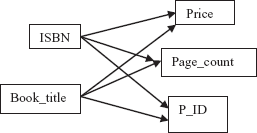
FD set: {STUD\_NO -> STUD\_NAME, STUD\_NO -> STUD\_STATE, STUD\_STATE -> STUD\_COUNTRY, STUD\_NO -> STUD\_AGE}

For this relation in table 4, STUD\_NO -> STUD\_STATE and STUD\_STATE -> STUD\_COUNTRY are true. So **STUD\_COUNTRY is transitively dependent** on STUD\_NO.

# 4. Boyce-Codd Normal Form (BCNF)

X -> Y is a trivial functional dependency if Y is a subset of X.

A relation schema R is in **BCNF** if and only if every non-trivial FD has a **candidate key** as its determinant.



BCNF is the simpler form of 3NF as it makes explicit reference to neither the first and second normal forms, nor to the concept of transitive dependence. Furthermore, it is stricter than 3NF as every relation which is in BCNF is also in 3NF, but vice versa is not necessarily true. A 3NF relation will not be in BCNF if there are multiple candidate keys in the relation such that

• the candidate keys in the relation are composite keys, and

• the keys are not disjoint, that is, candidate keys overlap.

# 5. 4th Normal Form (BCNF)

An attribute may multi-determine another (X→→Y). For example, a student (identified by **Student\_ID**) may take many courses (identified by **Course**). Thus **Student\_ID**→→**Course**. This is called a multivalued dependency.

A table violates fourth normal form when it contains two or more independent multivalued dependencies.

For example, assume that a student may take more than one course and have more than one major. Thus student has two multivalued dependencies **Student\_ID**→→**Course** and **Student\_ID**→→**Major**. 4NF is violated by the following table:

Table

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